Volatility and Dynamics in Agricultural and Trade Policy Impact Assessment – Modelling Advances Needed

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Different research worlds?

EAAE congress plenary session Ljubljana 2014:

The elegant world of analytical models with "On the pricing of undesirable state-contingent outputs" (Bob Chambers)

meets

"Resilience and why it matters for farm management" (Ika Darnhofer with conflict, collapse, reorganisation….)

The first just a precise version of the second? Not sure Stern (see JEL 2013) would agree with David Zilberman

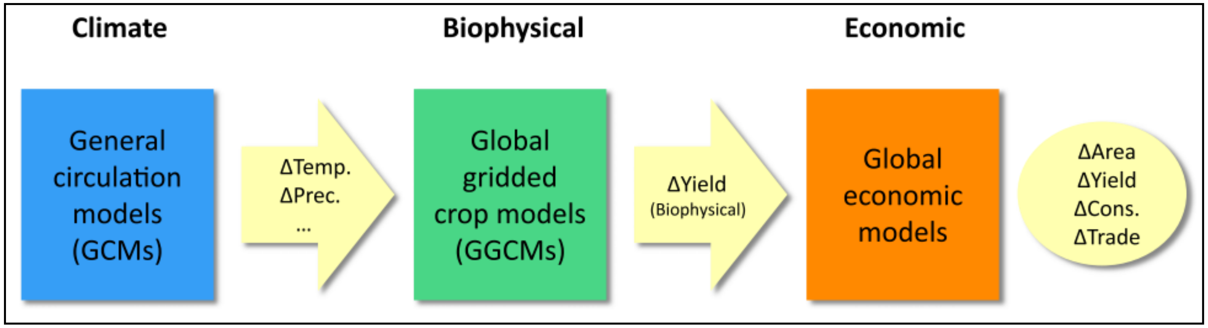
Objective

- To sketch dynamics / volatility gaps in ex-ante policy impact modelling
- To point at a direction of basic research / tool development to overcome some of the gaps in the long run
- To get your view on this

Examples on policy issues

- Food price volatility
  - Regulation of “speculation” on commodity futures markets
  - National and international storage policies and their relation to price spike probabilities
  - Producer safety nets, consumer support measures…
- Climate change impacts and policies
  - Extreme events (thresholds, integrals over time) is what matters most
  - Long-term projections are core (“structural change”, primary factor use development, induced technological change…)
  - Long-term impacts and adaptation (extreme events, conflict, break-up of economic structures…)

Climate change analysis today



Nelson et al., 2014. PNAS; IPCC, WG II, 2014

- No dynamic feedbacks
- No extreme events
- No endogenous technological change…
- Economic models are comparative static equilibrium models….

What matters for policy impacts?

- → Interaction between short and long-term variability (e.g. stocks – prices)
- → Distributions/probabilities (e.g. extreme events, budget outlays…)
- → Emerging properties through dynamic/spatial interaction of agents….(technological development / structural change in spatial environment…)
- → Structural breaks of behavioural functions / parameters at market level (conflict, institutional breakdown….

Policy model developments

Stochastics in comparative static equilibrium models

- FAPRI baseline — Westhoff et al., 2004, WP
- GTAP — Valenzuela et al., 2007, AJAE; Diffenbaugh et al., 2012, NCC
- …

→ Stochastic demand/supply shocks → stochastic equilibria

→ bringing together "medium-term" elasticities with fluctuations across different time resolutions

→ More fundamentally: volatility "in reality" is a path towards a moving target (exogeneous shocks and drivers) that is never reached

→ dynamics missing

Policy model developments

- Dynamic CGEs
- Dynamics in applied partial equilibrium modelling tools?

Féménia, Gohin 2011, EM
Gohin, Rault 2013, FP
Espinosa et al. 2013, EPS

Why don't we see more developments?

→ Structural dynamic models are very restrictive with regard to policy relevant details

→ E.g. storage models under relevant price expectations and market complexities

Stochastic dynamic policy simulation models?

TS models more structural....

- "Structural" time series models

> White, Pettenuzzo 2014, JE
> Gutierrez et al., 2014, AJAE
> Breman, Gardebroek, 2014, IATRC

→ Significant move towards policy relevance

→ But still far away from explicit modelling of policy instruments

→ Modelling relies on fixed parameter structure with implicit behaviour

→ New policies cannot be introduced except for very rare cases

Alternative: Agent based models

- Agent-based models of ag-sector
  - Start to get accepted in AgEcon journals
  - Laboratories for systems with dynamically interacting agents
  - Structural change, technology investment

Schreinemachers, Berger 2012, EM&S
Brady et al. 2012, LE
Oudendag et al. 2014, MAAI
Feil et al. 2012, ERAE

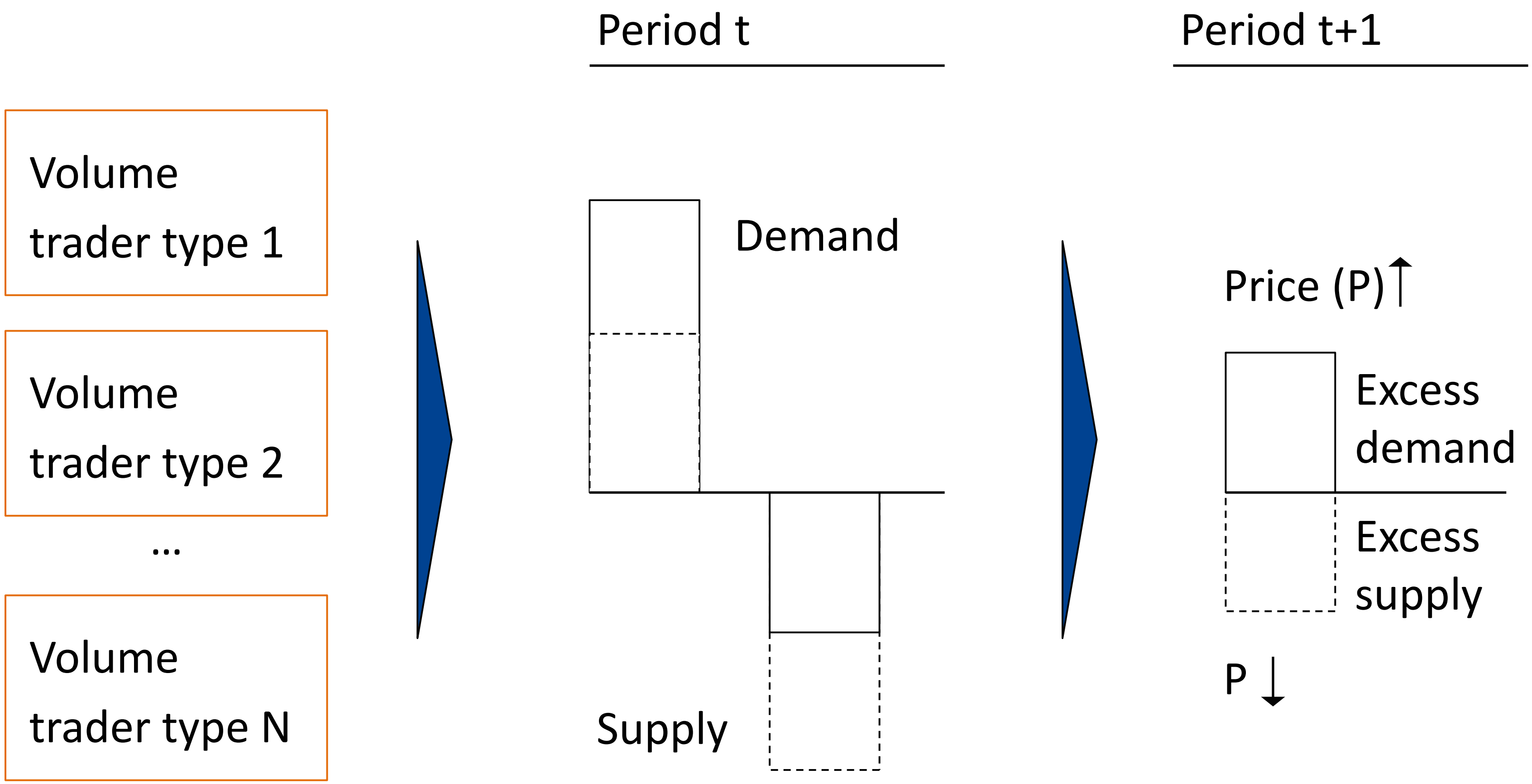
- At national/global product market level not yet employed in AgEcon
- But structural stochastic volatility models with heterogeneous agents in finance
- Challenge: empirical specification

Franke, Westerhoff 2011, CE
Franke, Westerhoff 2012, JED&C
Chiarella et al 2014, JEB&O

Example for empirical strategy

- Heterogeneous Agent Model (HAM) of corn futures market (Grosche, Heckelei 2014)
- Objective: simulate impact of financial investor entry through index funds on price levels and volatility
- Stylized trader types → weight in market depends on relative attractiveness of their strategies
- Parameter specification through Method of Simulated Moments (MSM)

Prices emerge sequentially from supply/demand disequilibria



Behavioral equations

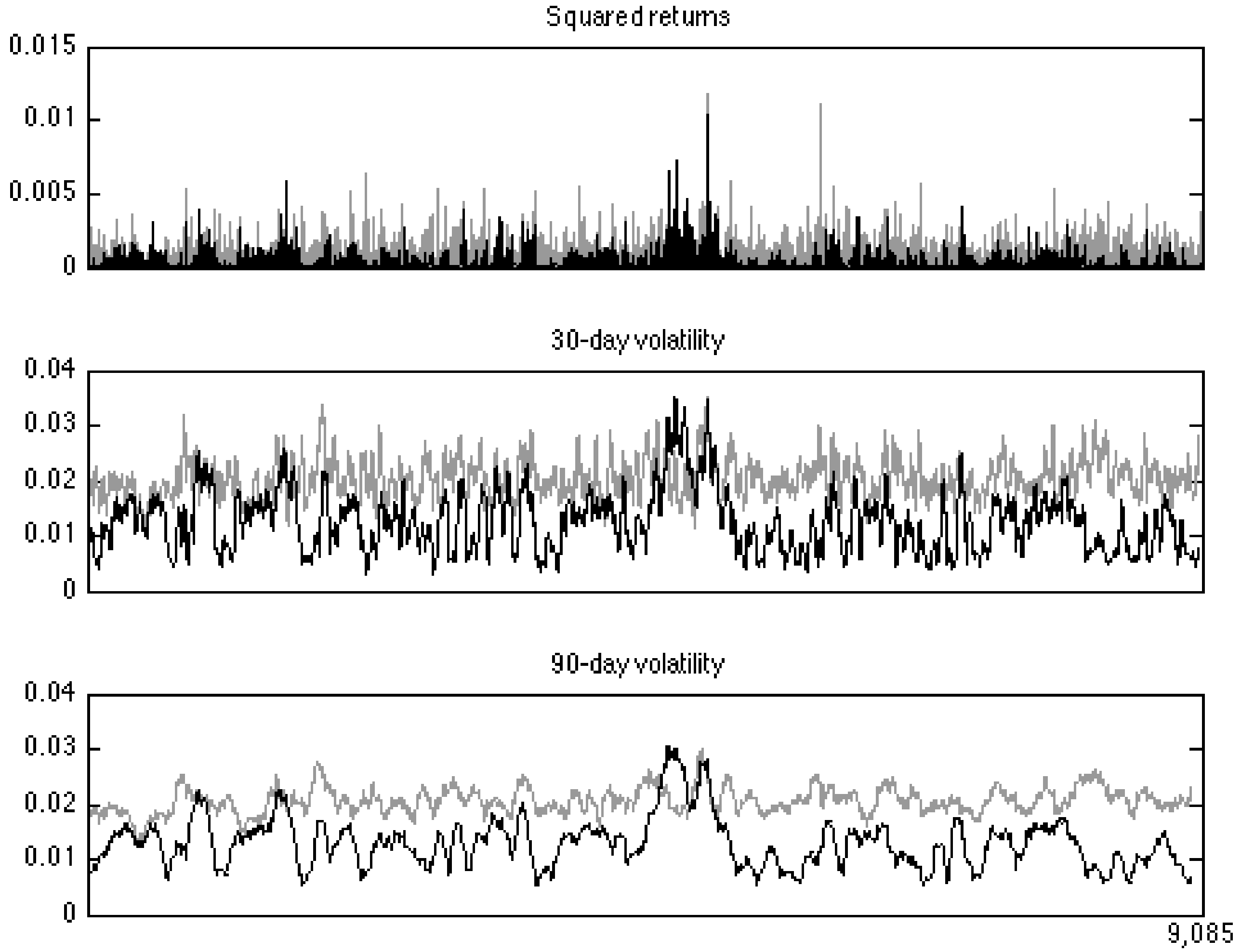
Commodity traders	Stylized strategy	Behavioral model		
Commercials	Fundamentalist	γ_{CO}	$(\bar{P}_F - P_t)$	$+ \ \varepsilon_t^{CO}$
Speculators	Chartist	γ_S	$(P_t - P_{t-1})$	$+ \ \varepsilon_t^{S}$
Portfolio managers	Weighted combination (via index funds)	γ_{PM}	$[\omega_F(\bar{P}_F - P_t) + \omega_C(P_t - P_{t-1})]$	$+ \ \varepsilon_t^{PM}$
	Short-selling constraint	Reaction coefficients	Reaction function	Independent stochastic effects

Parameter "estimation"

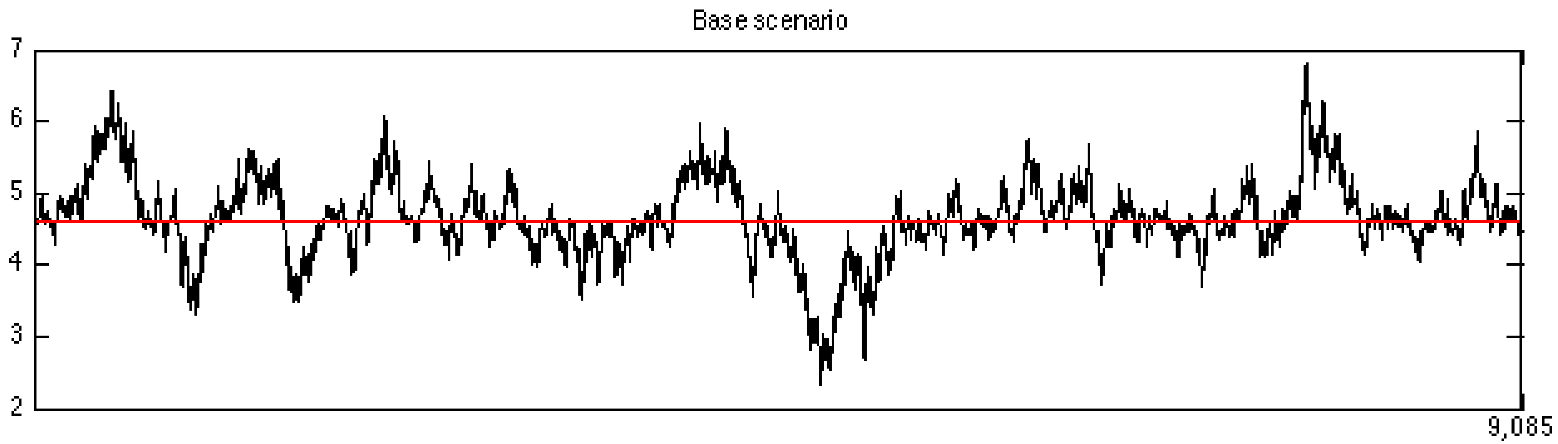
$$J = (m^{sim}(\theta) - m^{emp})' W (m^{sim}(\theta) - m^{emp})$$

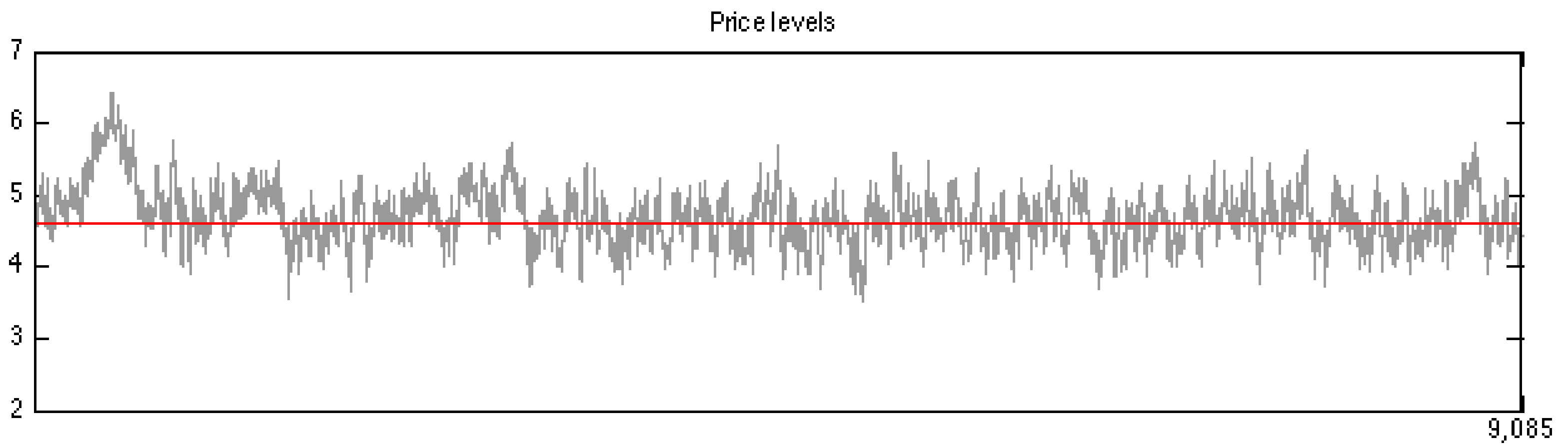
- Reaction coefficients, parameters determining strategy attractiveness (predisposition, reaction to herding, reaction to price misalignment), variances of stochastic volume components
- Empirical moments here "stylized facts" of financial asset returns
- Weight matrix uses estimated covariance matrix of moments

Volatility effects



Price level effects





Further possibilities?

- Use as tool for simulation of regulatory impacts on futures markets (position limits…)
- Develop meaningful link to physical markets (storage model, weather information and production forecasts….)
- Refinements of empirical specification in collaboration with structural time series econometric models

Conclusions

- Current ex-ante policy impact modelling at national and global level is weak on dynamics and volatility
- Nature of relevant policy issues implies bad news for traditional economic ex-ante modelling strategies
- We might have to model more of the actual price building process in the future to allow for
  → structural breaks in market relevant behaviour
  → “true” dynamic volatility across temporal scales
- Market level agent-based models might be a long-term help, but empirical approach difficult and long path to gain credibility in policy community